

California Environmental Protection Agency



**PERMEATION RATES OF SCEPTER
SELAR HIGH DENSITY POLYETHYLENE
PORTABLE FUEL CONTAINERS**

Engineering and Certification Branch
Monitoring and Laboratory Division

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PERMEATION RATES OF SCEPTER SELAR HIGH DENSITY POLYETHYLENE PORTABLE FUEL CONTAINERS

Introduction

The California Air Resources Board (CARB) staff tested several Scepter High-Density Polyethylene (HDPE) portable fuel containers (containers) to determine average permeation rates. Scepter submitted several 1 gallon, 2 gallon, 5 gallon and 6 gallon portable fuel containers to the CARB staff for evaluation. All the containers were treated, at different levels, with Selar. Containers were preconditioned with commercial fuel, refilled with Phase II California Reformulated Certification (CERT) fuel, and subjected to a variable temperature profile. Permeation rates were then determined gravimetrically during the month of September and October.

Test Protocol

Scepter submitted a total of 31 containers in June 2000, of which 13 were tested in September and 6 were tested between September and October. In July, 19 containers underwent the durability and preconditioning process, using commercial fuel, per CARB Test Method 513. All containers were stored at ambient temperature and pressure in flammable storage cabinets. After four weeks of ambient preconditioning, the containers were emptied; blown dry with compressed zero air, and immediately refilled with CERT fuel. The containers were then sealed using a hand held fusion welder and 1/4" thick HDPE coupons and leak tested as specified in Test Method 513 (a copy can be found at the CARB web site: <http://www.arb.ca.gov/regact/spillcon/spillcon.htm>).

Weight loss was used to determine relative permeation rates. Sealed containers were weighed using a high capacity balance with a sensitivity of ± 0.1 grams. After each container was weighed and the weight recorded, they were placed in the Sealed Housing for Evaporative Determination (SHED) and exposed to a 1-day/24-hour/1440-minute variable temperature profile (see Attachment 1). This process is considered our diurnal cycle (recurring every day). Containers were then post weighed after each 24-hour diurnal cycle and the weight loss calculated.

Results

Cumulative weight losses were determined for each container as a function of time. The containers underwent a total of thirteen diurnal cycles, but results are calculated using only ten cycles, each cycle is 24-hours. The first three days of test data were not used in determining individual per container permeation rates due to high variability. A summary of all test results can be found in Attachment 2.

The average permeation rate from the 5 gallon container with 6% Selar designated SCPT 5AS-6 was determined to be 0.10 grams/gallon/day. This rate is based on data averaged from tests of one individual container and represents a total of 10 individual 24-hour diurnal cycles.

The average permeation rate from the 6 gallon container with 4% Selar designated SCPT 5AT-6 was determined to be 0.08 grams/gallon/day. This rate is based on data averaged from tests of one individual container and represents a total of 10 individual 24-hour diurnal cycles.

The average permeation rate from the 5 gallon container with no treatment designated SCPT S5-0 was determined to be 0.62 grams/gallon/day. This rate is based on data averaged from tests of one individual container and represents a total of 10 individual 24-hour diurnal cycles.

The average permeation rate from the 2 gallon container with 8% Selar designated EVNRD 2C-8 was determined to be 0.44 grams/gallon/day. This rate is based on data averaged from tests of one individual container and represents a total of 10 individual 24-hour diurnal cycles.

The average permeation rate from the 1 gallon containers with 8% Selar designated SCPT 1A-8, SCPT 1B-8 and SCPT 1C-8 was determined to be 0.83 grams/gallon/day. This rate is based on data averaged from tests of three individual containers and represents a total of 30 individual 24-hour diurnal cycles.

The average permeation rate from the 1 gallon containers with 10% Selar designated SCPT 1A-10, SCPT 1B-10 and SCPT 1C-10 was determined to be 0.83 grams/gallon/day. This rate is based on data averaged from tests of three individual containers and represents a total of 30 individual 24-hour diurnal cycles.

The average permeation rate from the 1 gallon containers with 12% Selar designated SCPT 1A-12, SCPT 1B-12 and SCPT 1C-12 was determined to be 1.04 grams/gallon/day. This rate is based on data averaged from tests of three individual containers and represents a total of 30 individual 24-hour diurnal cycles.

The average permeation rate from the 2 gallon container with 6% Selar designated EVNRD 2A-6 was determined to be 0.28 grams/gallon/day. This rate is based on data averaged from tests of one individual container and represents a total of 10 individual 24-hour diurnal cycles.

The average permeation rate from the 2 gallon container with 10% Selar designated EVNRD 2B-10 was determined to be 0.23 grams/gallon/day. This

rate is based on data averaged from tests of one individual container and represents a total of 10 individual 24-hour diurnal cycles.

The average permeation rate from the 6 gallon container with 6% Selar designated SCPT 5AT-6 was determined to be 0.06 grams/gallon/day. This rate is based on data averaged from tests of one individual container and represents a total of 10 individual 24-hour diurnal cycles.

The average permeation rate from the 6 gallon container with 8% Selar designated SCPT 6-8 was determined to be 0.05 grams/gallon/day. This rate is based on data averaged from tests of one individual container and represents a total of 10 individual 24-hour diurnal cycles.

The average permeation rate from the 5 gallon container with 4% Selar designated SCPT 5AS-4 was determined to be 0.13 grams/gallon/day. This rate is based on data averaged from tests of one individual container and represents a total of 10 individual 24-hour diurnal cycles.

The average permeation rate from the 5 gallon container with 8% Selar designated SCPT 5AS-8 was determined to be 0.08 grams/gallon/day. This rate is based on data averaged from tests of one individual container and represents a total of 10 individual 24-hour diurnal cycles.

Attachment 1

1 Day / 24 Hour / 1440 Minute Variable Temperature Profile

HOUR	MINUTE	ELAPSE TIME (MINUTES)	TEMPERATURE (°F)
0	0	1440	65.0
1	60	1380	66.6
2	120	1320	72.6
3	180	1260	80.3
4	240	1200	86.1
5	300	1140	90.6
6	360	1080	94.6
7	420	1020	98.1
8	480	960	101.2
9	540	900	103.4
10	600	840	104.9
11	660	780	105.0
12	720	720	104.2
13	780	660	101.1
14	840	600	95.3
15	900	540	88.8
16	960	480	84.4
17	1020	420	80.8
18	1080	360	77.8
19	1140	300	75.3
20	1200	240	72.0
21	1260	180	70.0
22	1320	120	68.2
23	1380	60	66.5
24	1440	0	65.0

Attachment 2

PERMEATION TEST RESULTS

September/October 2000

Diurnal Cycles* (# 24 hr cycles)	Container Identification	Container Mfg.	Barrier Treatment	Container Volume	Test Dates	Fuel Type	Avg. Loss (g/gal/day)
10	SCPT 5AS-6	Scepter	Selar 8%	5 gallon	9/8 - 9/22	CERT	0.10
10	SCPT 5AT-4	Scepter	Selar 4%	6 gallon	9/8 - 9/22	CERT	0.08
10	SCPT S5-0	Scepter	None	5 gallon	9/8 - 9/22	CERT	0.62
10	EVNRD 2C-8	Scepter	Selar 8%	2 gallon	9/8 - 9/22	CERT	0.44
10	EVNRD 2A-6	Scepter	Selar 6%	2 gallon	9/23 - 10/7	CERT	0.28
10	EVNRD 2B-10	Scepter	Selar 10%	2 gallon	9/23 - 10/7	CERT	0.23
10	SCPT 5AT-6	Scepter	Selar 6%	6 gallon	9/23 - 10/7	CERT	0.06
10	SCPT 6-8	Scepter	Selar 8%	6 gallon	9/23 - 10/7	CERT	0.05
10	SCPT 5AS-4	Scepter	Selar 4%	5 gallon	9/23 - 10/7	CERT	0.13
10	SCPT 5AS-8	Scepter	Selar 8%	5 gallon	9/23 - 10/7	CERT	0.08
10	SCPT 1A-8	Scepter	Selar 8%	1 gallon	9/8 - 9/22	CERT	0.98
10	SCPT 1B-8	Scepter	Selar 8%	1 gallon	9/8 - 9/22	CERT	0.85
10	SCPT 1C-8	Scepter	Selar 8%	1 gallon	9/8 - 9/22	CERT	0.65
							Average 0.83
10	SCPT 1A-10	Scepter	Selar 10%	1 gallon	9/8 - 9/22	CERT	0.88
10	SCPT 1B-10	Scepter	Selar 10%	1 gallon	9/8 - 9/22	CERT	0.79
10	SCPT 1C-10	Scepter	Selar 10%	1 gallon	9/8 - 9/22	CERT	0.83
							Average 0.83
10	SCPT 1A-12	Scepter	Selar 12%	1 gallon	9/8 - 9/22	CERT	1.32
10	SCPT 1B-12	Scepter	Selar 12%	1 gallon	9/8 - 9/22	CERT	0.95
10	SCPT 1C-12	Scepter	Selar 12%	1 gallon	9/8 - 9/22	CERT	0.84
							Average 1.04

*The results are based on 10 diurnal cycles, although 13 were performed. The first 3 days were not included because of high variability.